

Approved by:

_____/_____/_____
Process Engineer_____/_____/_____
Equipment Engineer

1 SCOPE

The purpose of this document is to detail the use of the Trion Orion PECVD. All users are expected to have read and understood this document. It is not a substitute for in-person training on the system and is not sufficient to qualify a user on the system. Failure to follow guidelines in this document may result in loss of privileges.

2 REFERENCE DOCUMENTS

- Material Safety Data Sheets for process gasses
- Appropriate Tool Manuals

3 DEFINITIONS

HV- High Voltage

GRC- Gas Reactor Column

4 TOOLS AND MATERIALS

4.1 General Description

The Trion Orion PECVD is a single chamber Plasma Enhanced Chemical Vapor Deposition system with a Triode configuration featuring two different RF sources for plasma deposition and stress relief. PECVD processing involving SiH₄, NH₃, N₂O, CF₄, N₂ and O₂ is available. Both Triode and Normal PECVD recipes can be run using the gasses installed. PECVD processes include Silicon Oxide and Silicon Nitride. Triode Recipes include Triode Oxide, Triode Oxyntiride and Triode Nitride. Both PECVD and Triode PECVD have clean recipes using CF₄ and O₂. It operates with a heated chuck and can give high rates of deposition as well as low stress films. The system has a Windows XP based operating system and the latest software available from Trion Technologies. It is not the same as the Trion Minilock, Trion Phantom RIE or the Trion ICP-RIE and qualification on the other Trion tools does not qualify you on this tool.

5 SAFETY PRECAUTIONS

5.1 Hazards to the Operator

- 5.1.1 **Gases** – The system uses hazardous gases including silane (SiH_4) and ammonia (NH_3) as well as N_2O , CF_4 , N_2 and O_2 . Read material safety sheets (SDS) and be familiar with hazards and safety controls to prevent an accident.
- 5.1.2 **Electrical** - This system uses high voltages and RF energy to process wafers. Only operate with all covers in place.
- 5.1.3 **Mechanical** – There are pinch points on the tool. Lid opens and closes automatically.
- 5.1.4 **Thermal** – The system runs at temperatures up to 400C. Use caution when unloading wafers.

5.2 Hazards to the Tool

- 5.2.1 **Wafer size** - This tool is only intended for 6” wafers and 6” carriers. See the SMFL process engineer if you are using carriers.
- 5.2.2 **Recipes** – Do not edit any recipes without the approval of Process Engineering. Users may edit time only.
- 5.2.3 **Contamination** – Do not process wafers with gold, copper or photoresist on them. For other metals, check with staff.
- 5.2.4 **The Gas Reactor Column (GRC) Warm up** – The GRC must be at temperature to safely dispose of pyrophoric Silane. The GRC must remain on for **20 minutes** after the completion of a run to allow the purge of the pumps and lines. Never operate the tool if there is any problem with the GRC. All processing must be completed by 4:30PM week days.
- 5.2.5 **Chamber Cleans** – A clean recipe is used to prevent buildup and flaking of material from the chamber lid and is critical to obtaining good process results. It is recommended that the clean be run after every 0.5um of deposition, whenever switching deposition materials and at the end of your process. Additionally a clean may be required before starting if it has been longer than 24 hours.

6 INSTRUCTIONS

6.1 Gas Reactor Column (GRC) Warm up

- 6.1.1 In the service chase #2755, ensure the N₂ manifold (located immediately on your right hand side as you enter the service chase) 3 valves labeled **Trion PECVD Process**, **Trion PECVD Purge/Vent** and **GRC** are on. The pressures should be marked on the gages.



- 6.1.2 Start the GRC for the PECVD by turning the red switch to the **On** position and verify that the heater is also on (1). The system will alarm. Select **Reset** and **Beacon Cancel**. The alarm will stop after 15 seconds. Warm up time is approximately 3 hours.
- 6.1.3 If the system alarms during warm up, select **Reset** and **Beacon Cancel**.

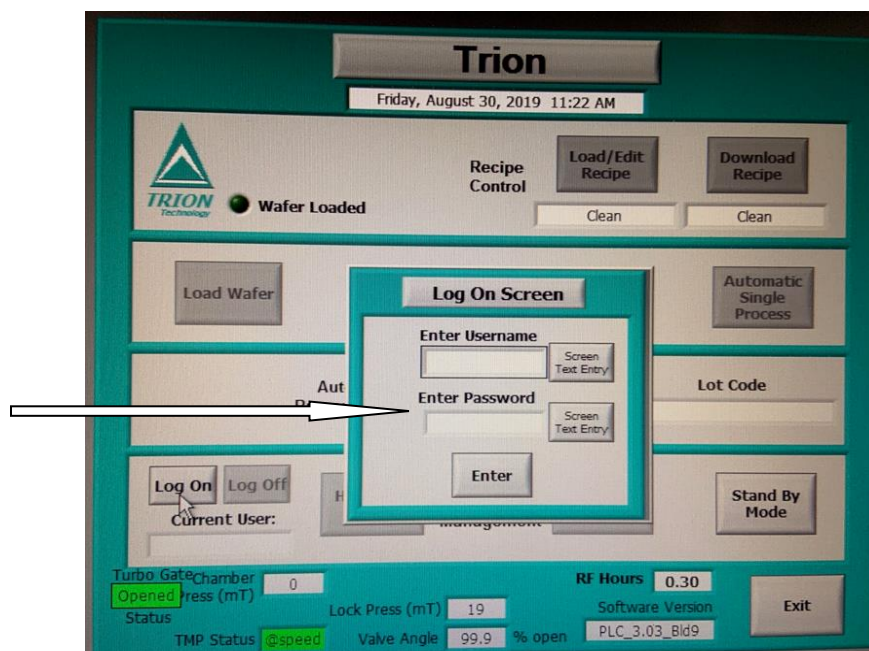
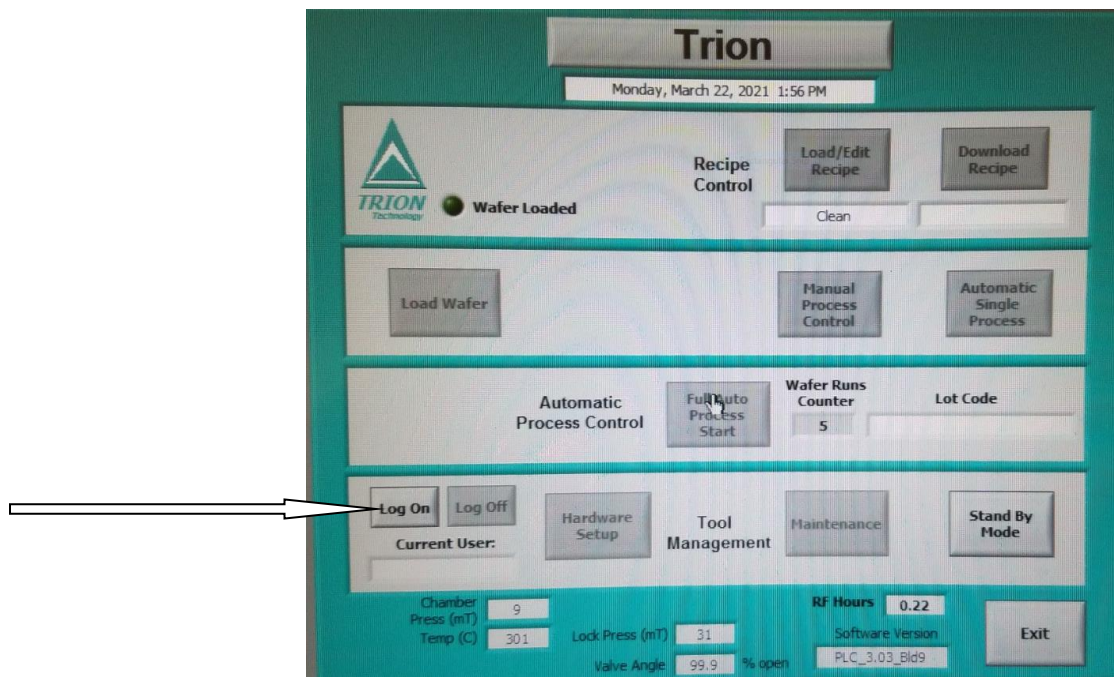
6.2 Enabling Gas Flow

- 6.2.1 Verify that the GRC is warmed up with no red error lights.
- 6.2.2 Make sure that the tool is swiped in on Card Swipe 3.
- 6.2.3 Check the DOD Toxic Gas Monitor in the back hall to ensure it is operational. Check that the N₂ latch in the red box mounted on the wall is enabled as well. The yellow lamp in the Red Gas Control box must be illuminated.
- 6.2.4 Switch on the gasses you need for your process in the Red box. These gasses will remain on and staff will shut them off during end of day shut down.

6.3 Log On to the Computer

6.3.1 If the Standby Mode screen appears press **Cancel** to go to the main screen

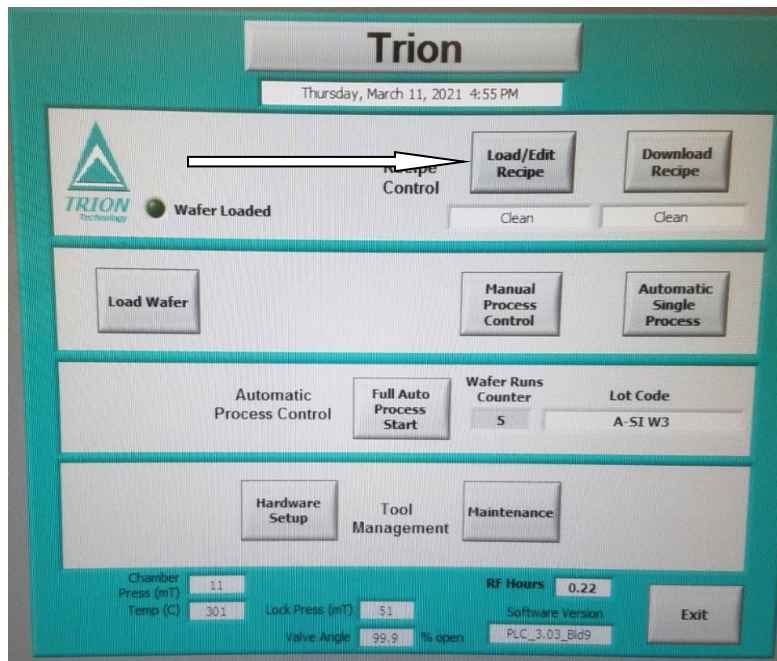
6.3.2 From the MAIN Screen press **Log On** at the bottom left corner. Type **user** for user name and **user** as password. Press **Enter**.



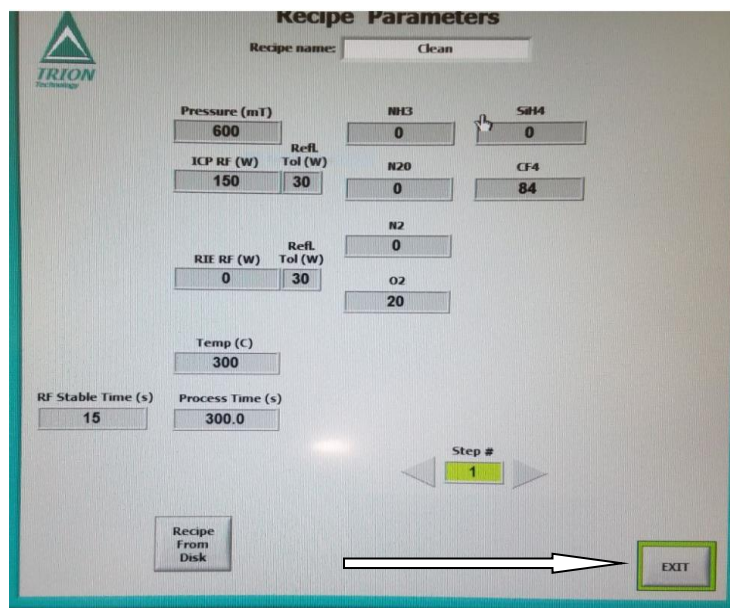
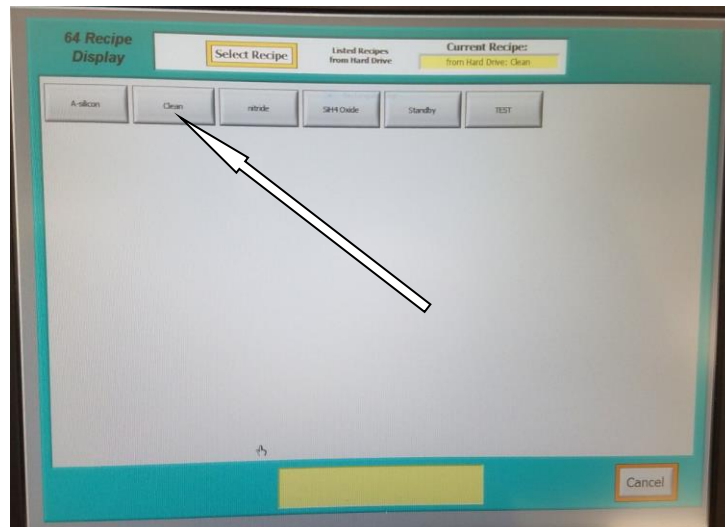
6.4 Run Clean Recipe

6.4.1 A clean recipe is used to prevent buildup and flaking of material from the chamber lid and is critical to obtaining good process results. It is recommended that the clean be run after every 0.5um of deposition, whenever switching deposition materials and at the end of your process. Additionally a clean is required before starting if it has been longer than 24 hours.

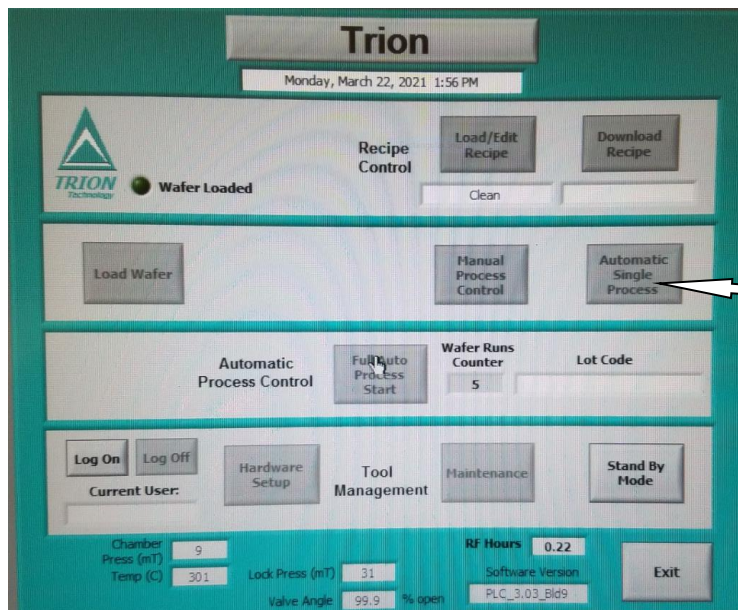
6.4.2 To load the **Clean** recipe press **Load/Edit Recipe**.



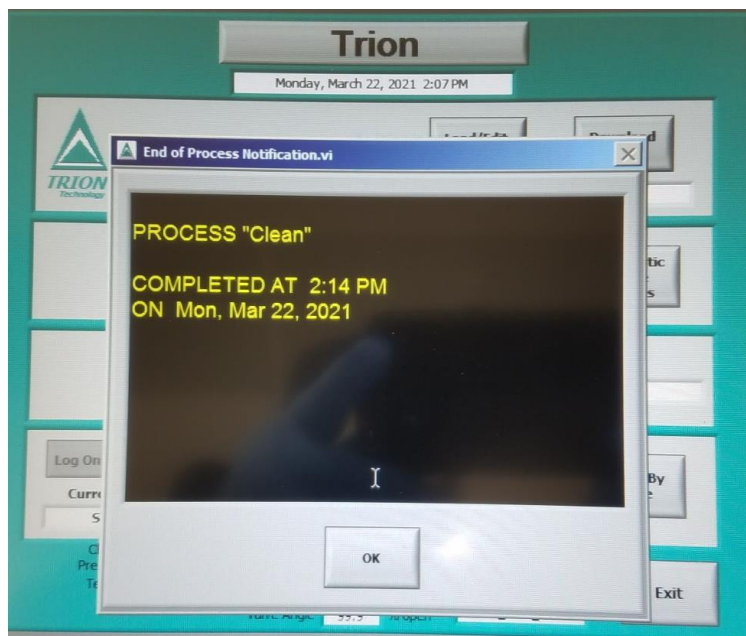
- 6.4.3 The **64 Recipe Display** screen will come up. Select the **Clean** recipe. The process time is 600 seconds. Always run clean before you run any other process. Press **Exit** to leave the **Recipe Parameters** screen. No wafer is used for the clean.



- 6.4.4 The MAIN Screen should appear with TRION at the top. Select **Automatic Single Process**, enter the lot identity and then touch anywhere else in the block and enter will appear in the green box. Press **Enter**. Your Process will start and run the Clean Recipe.



- 6.4.5 Press **OK** on the End Of Process Notification.



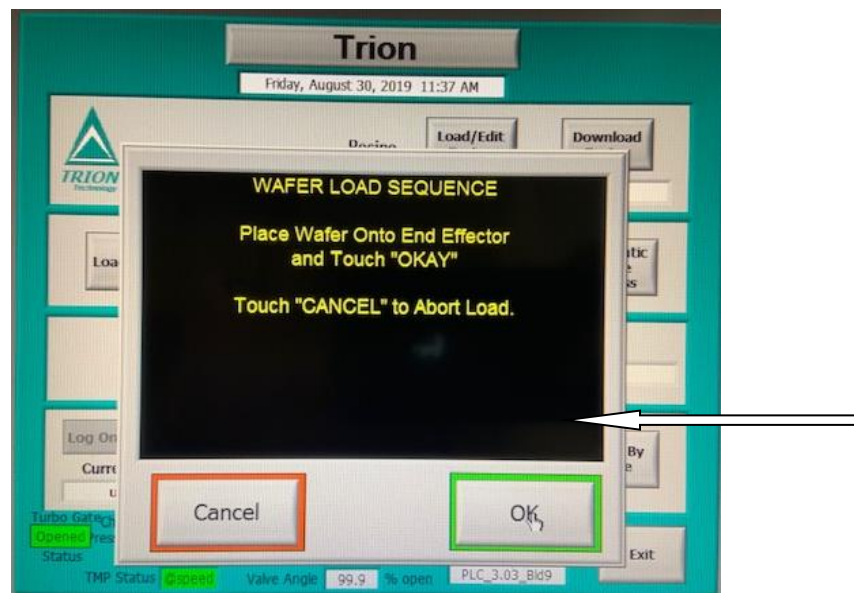
6.5 Loading a Wafer

- 6.5.1 Select **Load Wafer** on the Main Screen and it will ask if you want to vent the load lock first. Press **Vent Lock First**.



- 6.5.2 When vented, the load lock will open and WAFER LOAD SEQUENCE screen will display. Place wafer onto End Effector and touch **OK**.

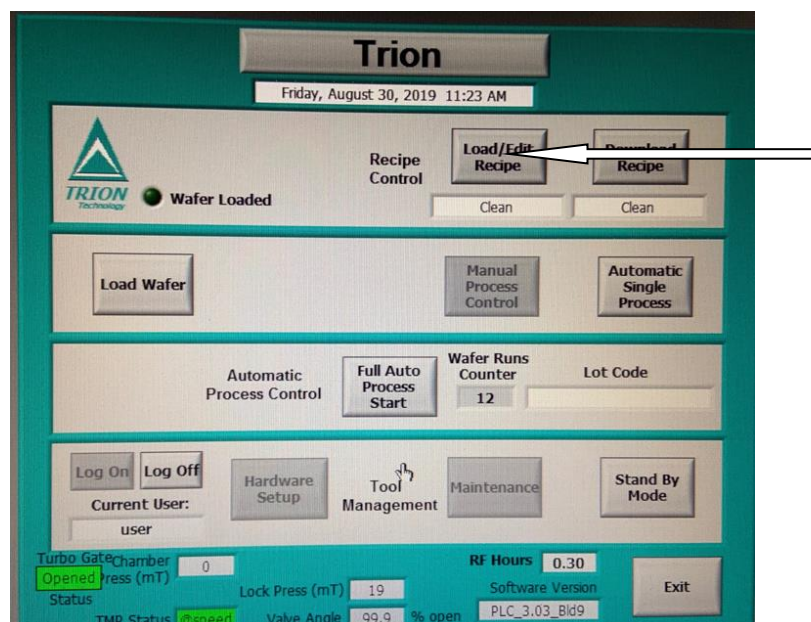




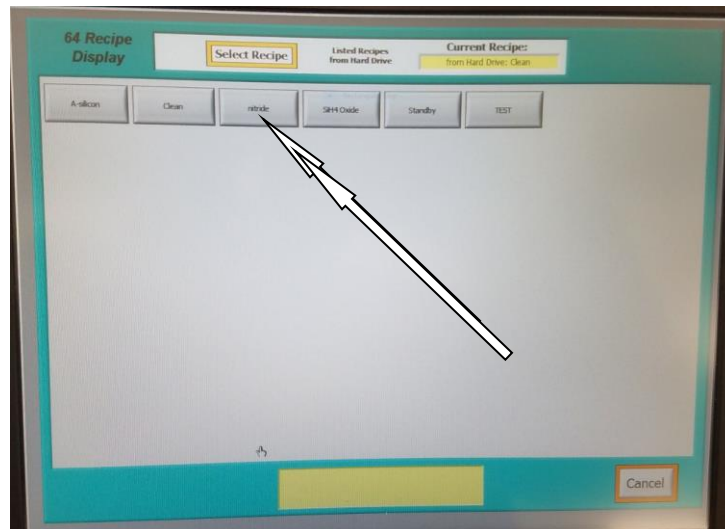
- 6.5.3 LID CLOSING screen appears followed by the WAFER LOAD SEQUENCE screen. Once the lock pressure reaches 400mT the wafer should load into the chamber. Once loaded it returns to the MAIN screen.

6.6 Processing a Wafer

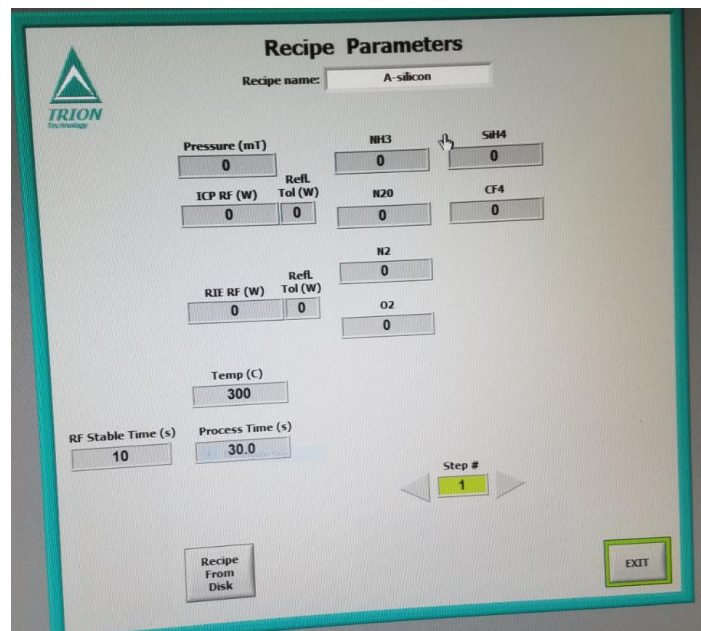
- 6.6.1 A clean should be run after every 0.5um of deposition, whenever switching deposition materials and at the end of your process. It is possible to leave the wafer pumped down in the load lock if a 2nd deposition is needed on the same wafer.



- 6.6.1 Press **Load/Edit Recipe**. The 64 Recipe Display screen will come up. Select the desired process recipe.



- 6.6.2 In the Recipe Parameters Screen, check all steps to ensure the recipe is correct. Edit the process time in Step 3. Verify the gasses, power settings and pressure for your process. Press **Exit**.



Recipe Parameters

Recipe name: nitride

Pressure (mT) 1200 NH3 36 SiH4 16

ICP RF (W) 50 Refl. Tol (W) 0 N2O 0 CF4 0

RIE RF (W) 0 Refl. Tol (W) 0 N2 200

O2 0

Temp (C) 300

RF Stable Time (s) 10 Process Time (s) 120.0

Delete Recipe File

Create New Recipe

Recipe From Disk

Save Recipe to Disk

EXIT

Step # 2

- 6.6.3 Press **AUTOMATIC SINGLE PROCESS**. If you use lot codes enter it. Press **ENTER** (even if you entered nothing). The Chamber Process Status Screen appears and runs the selected process.

Trion

Monday, March 22, 2021 2:07 PM

Wafer Loaded

Recipe Control

Load/Edit Recipe

Download Recipe

Clean

Clean

Automatic Single Process

Lot Code

Stand By Mode

Set Lot Code:

Screen Text Entry

Add Comment/Note

Screen Text Entry

Log On

Log Off

Current User: SMFL

Chamber Press (mT) 17

Temp (C) 302

Lock Press (mT) 257

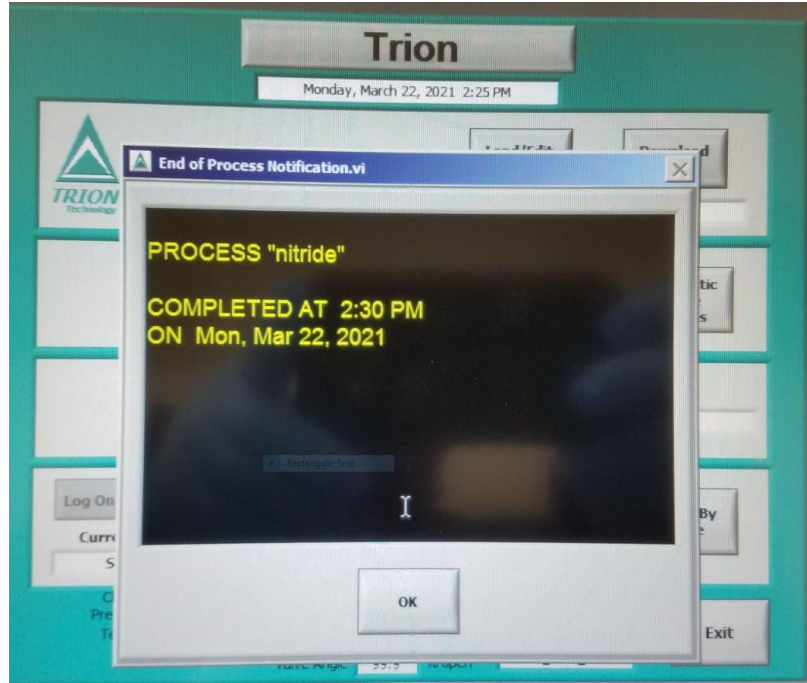
Valve Angle 99.9 % open

RF Hours 0.22

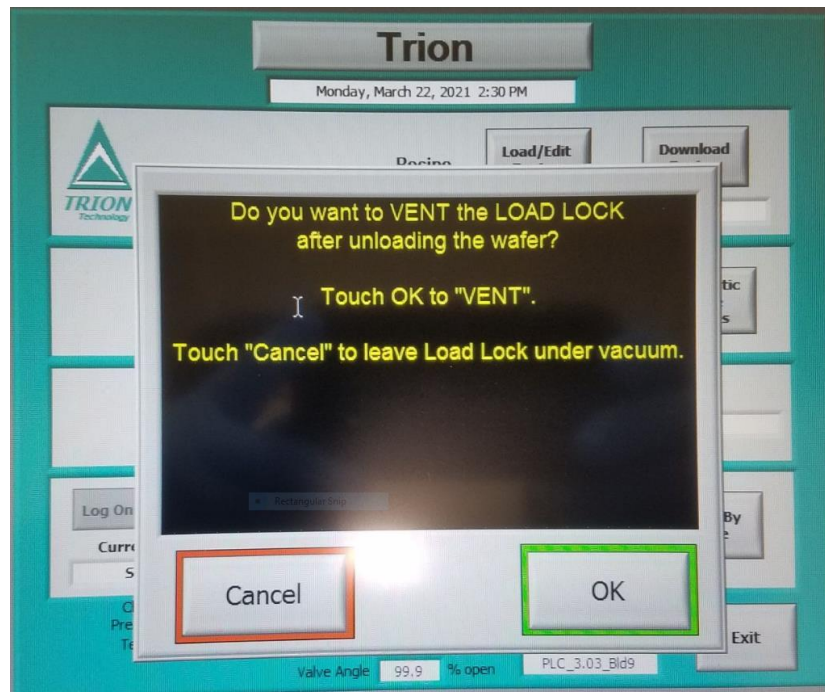
Software Version PLC_3.03_Bld9

Exit

6.6.4 Press **OK** when the **END OF PROCESS NOTIFICATION** screen appears.



6.6.5 Once the MAIN screen appears press **UNLOAD WAFER**. Press **OK** to vent the Load Lock after unloading the wafer. If you need to do another deposition on the same wafer, you can leave it in the load lock while running the chamber clean and then load it again for the next deposition.

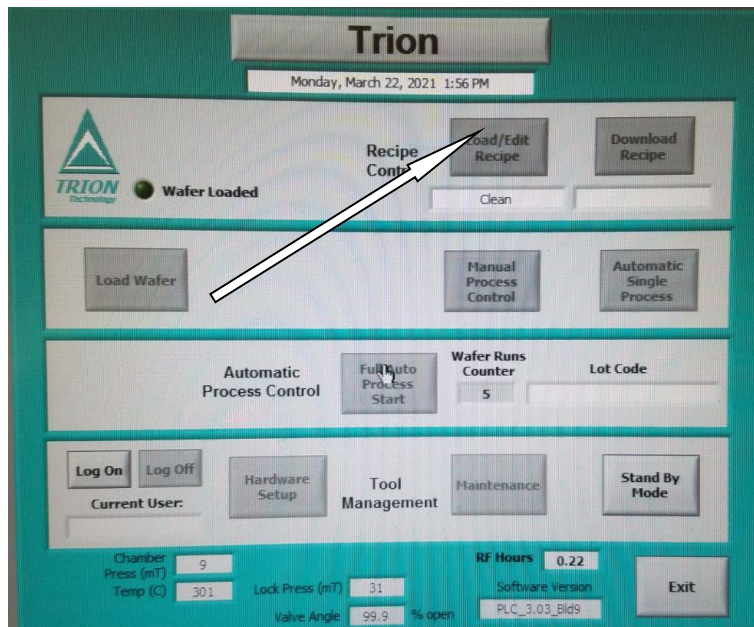


6.6.6 The chamber will open and the END OF PROCESS notification pops up. Unload your sample and load another if you are continuing the same process and repeat starting at 6.6.1. Run a clean recipe if you are changing the process to different gasses.

6.6.7 Press OK to close the lid then press OK to pump down the load lock.

6.7 FULL AUTO MODE

6.7.1 Press LOAD/EDIT RECIPE and review all process parameters and edit time as needed for your process.



6.7.2 Press Full Auto Process and follow the on screen prompts. Once completed and with your wafer removed close the lid and press OK to pump the Load Lock.

6.8 ENDING A RUN

6.8.1 Press LOG OFF

6.8.2 Press STANDBY MODE.

6.8.3 CARD SWIPE OUT

6.9 Errors during Run

6.9.1

7 APPROPRIATE USES OF THE TOOL

7.1 This tool is only intended for 6" wafers and carriers.

7.2 Do not process wafers with gold or copper on them.

8 ATTACHMENTS

R·I·T

Title: Trion Orion PECVD

Semiconductor & Microsystems**Fabrication Laboratory****Revision: B****Rev Date: 05/21/2021****REVISION RECORD**

Summary of Changes	Originator	Rev/Date
<u>Original Issue</u>	Bruce Tolleson	A-03/23/2021
Expanded and included more information on cleans	O'Brien	B-05/21/2021